

DECARBONIZATION

Low-carbon Construction Materials

Protect the Ecosystem

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Targets

SBT Carbon Reduction Target



2025

2030

2050

**1.5°C PATHWAY****NET ZERO**

EP100 Energy Productivity

Energy productivity +50% in 2040 | Base year: 2016

Low-Carbon Products

→Portland Limestone Type IL Cement (-15% CO₂e)

→Portland Limestone Type IL Cement

Concrete (-40% CO₂e)

100% Replacement of Portland Type I Cement by 2026

Clinker to Cement Ratio 2030 0.780

Water Resource Management

→ Water Consumption Intensity:

0.000225 Million Liters/ Metric Ton of Cementitious Materials | Taiwan & Mainland China

→ Water Withdrawal Intensity: Plants in Taiwan -50%; Plants in Mainland China -30% | Base year: 2016



2023/

Performance Highlights

Greenhouse Gas Emissions ↘

Carbon Emission Intensity of Cement

-9.1%0.686 Metric Tons CO₂e/ Metric Ton of Cementitious Materials

Taiwan & Mainland China Scope 1&2

Base year: 2016

Carbon Emission Intensity of Concrete

-8.53%247.93 kg of CO₂e/ m³ of Concrete

Compared to 2021

Air Pollution Management →

NO_x 383**SO_x 41****TSP 22**

Cement Plants in Taiwan & Mainland China



Unit: g/t Clinker

Water Resource Management ↘

Cement Plants

Water Consumption Intensity

Cement Plants in Taiwan & Mainland China

0.000236 Million Liters/Metric Ton of Cementitious Materials

(Environmental Water Used on the Plants Excluded)

Water Withdrawal Intensity

Base year: 2016

0.000245 Million Liters /Metric Ton of Cementitious Materials

Taiwan **-35.50%**Mainland China **-5.14%**

RMC Plants Water Withdrawal

100%

Intensity

0.00013 Million Liters/ m³ of Concrete

Energy Management

Cement Plants in Taiwan & Mainland China

CLIMATE GROUP **EP100**

— Energy Productivity 0.477 Thousand of NTD of Revenues/GJ

+45.9%

Base year: 2016

Power Generation by Waste Heat Recovery Equivalent to Purchased Electricity

35%



RESOURCE RECYCLING

Targets

Ratio of Alternative Raw Materials

22% by 2030 | Taiwan & Mainland China

The Thermal Substitution Rate (TSR) of Alternative Fuels

35% by 2030 | Taiwan & Mainland China

Overseas Cement Business



OYAK

2030

Aslan Plant 70%

Ankara Plant 65%



CIMPOR

2025

Alhandra Plant 80%

2024

Souselas Plant 65%



2023/ RESOURCE RECYCLING

Performance Highlights

Cement

Resource Recycling Rate 24.78%

TSR of Alternative Fuels 13%

Alternative Raw Materials Contained 19%

Taiwan & Mainland China

Concrete

Alternative Raw Materials Contained

43.25%

Waste Treated for Industries
1,155,684 TonsEquivalent to Taiwan's
Total Industrial Waste 5.77%

Household Waste Processed 13,762 Tons



OVERSEAS CEMENT BUSINESS



OYAK

Aslan Plant_61% | Ankara Plant_40%



CIMPOR Overall

36%

Alhandra Plant 32%

Souselas Plant_43%

Loule Plant_33%



2.1_

Low-carbon Construction Materials

In the new global carbon pricing era, TCC supports carbon pricing policies to curb carbon leakage and leverages carbon strategies to boost corporate innovation and national industry competitiveness.



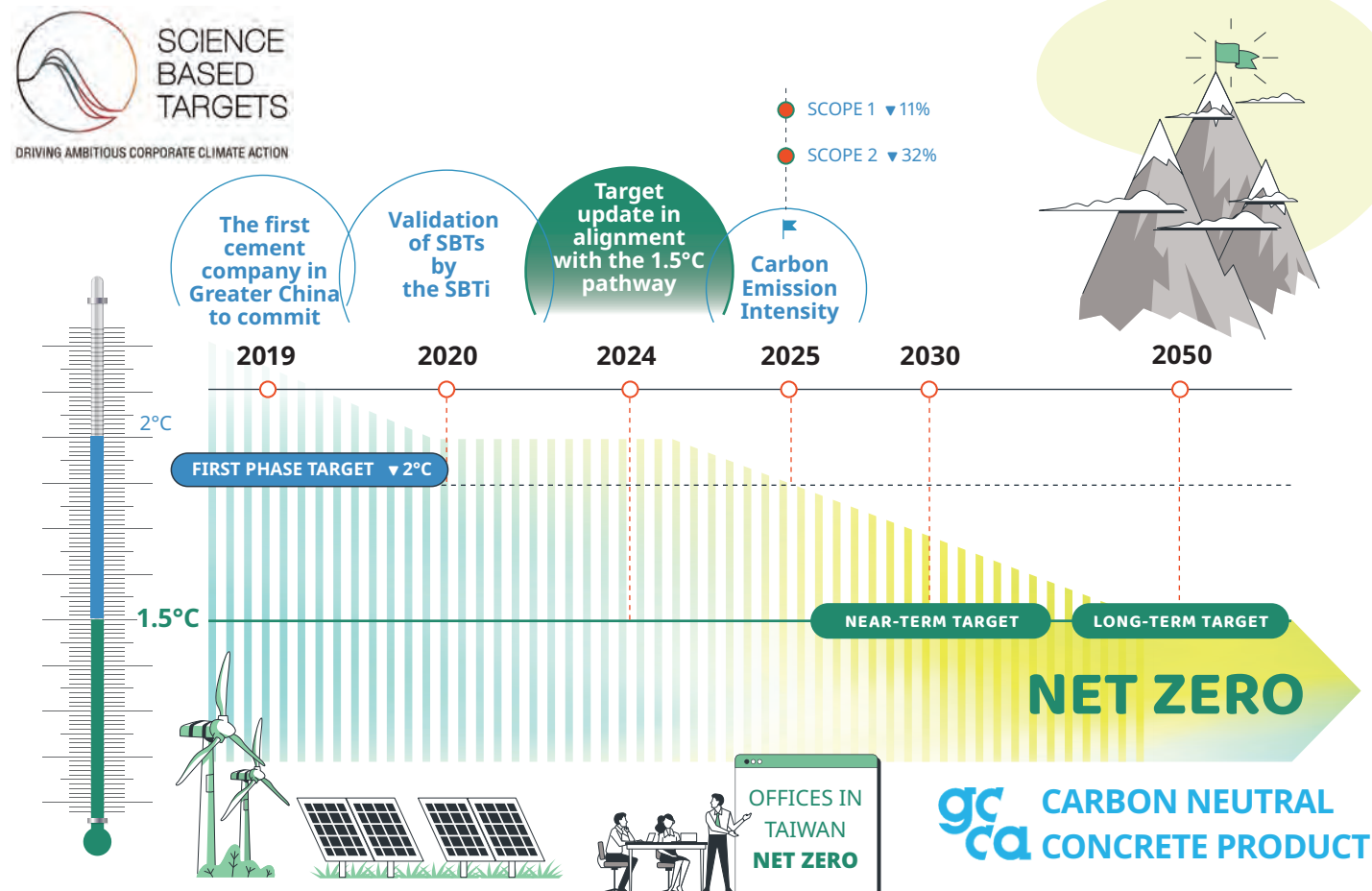
→ Science Based Targets & Management System for Carbon Reduction

TCC initiated the Science Based Target (SBT) project in 2019, aligning with Intergovernmental Panel on Climate Change (IPCC) and International Energy Agency (IEA) methods to adopt a Well-Below 2°C scenario (WB2D) for 2025 carbon reduction goals. TCC commits to reducing Scope 1 and 2 GHG emissions by 11% and 32% per ton of cementitious materials by 2025 from a 2016 base year. TCC was validated one and a half year ahead of schedule in 2020. Alongside 40 global cement firms within Global Cement and Concrete Association (GCCA), TCC aims for carbon-neutral concrete by 2050, setting a 30-year low-carbon transformation roadmap.

TCC aims to revise its 2030 SBT to meet

THE 1.5°C TARGET by 2024.

Concurrently, TCC will commit to 2050 net-zero goals and join the SBTi validation pilot, ensuring consistent carbon reduction monitoring.



→ AI-powered Carbon Management Platform

TCC's AI platform, launched in 2019, automates daily carbon emission calculations for cement and concrete using the Cradle-to-Gate LCA method. Plants send production data daily, which the platform uses to compute raw material, fuel, and energy carbon emissions, and advises on optimal alternative raw material and fuel use. By 2024, environmental tech firms under TCC Group Holdings and TCC DAKA Renewable Resource Recycling Center will join the system to enhance carbon management.

Compensation at TCC is tied to SBTs and alternative fuel use KPIs. Quarterly and annual bonus factors are set, and the platform provides a visual presentation of the achievement rate to encourage proactive measures.

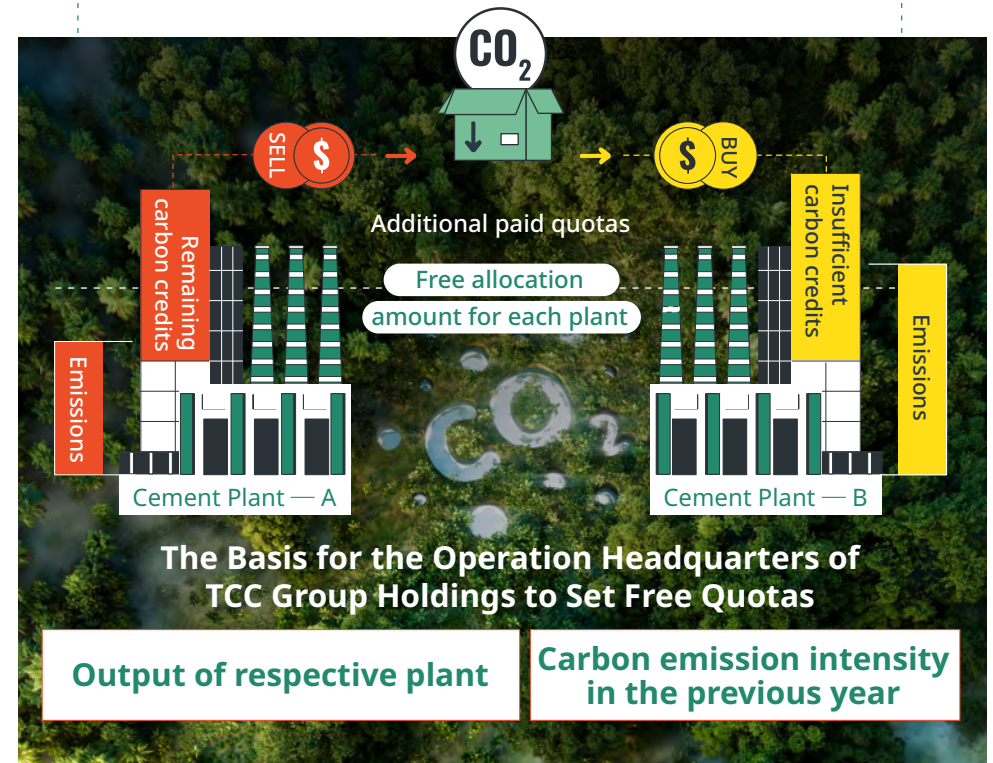


SBT Carbon Reduction Progress Tracking

→ Internal Carbon Pricing

To promote eco-friendly investments and energy efficiency, TCC set an internal carbon price of NT\$300/ton-CO₂e in Taiwan, based on LSE's guidelines, and RMB101/ton-CO₂e in Mainland China, in anticipation of the cement industry's inclusion in carbon trading. This pricing aids in assessing the impact on capital investments and operations. To streamline budgeting for capital expenditures, maintenance, and energy saving projects, TCC factors in carbon costs alongside existing expenses. This inclusion in the internal rate of return calculation reinforces department-wide motivation for carbon reduction.

CARBON TRADING SYSTEM



The Basis for the Operation Headquarters of TCC Group Holdings to Set Free Quotas

Output of respective plant

Carbon emission intensity in the previous year

→ Internal Carbon Trading

In 2024, TCC introduced an internal carbon trading platform, inspired by Guangdong Pilot ETS and EU ETS, to help plants control emission intensity and align product sales with market needs. Starting in 2024, TCC's Finance Department will issue quarterly carbon budget reports to spur competition and collaboration among plants. Year-end carbon allowance settlements will influence performance appraisals. Cement plants in Taiwan and Mainland China can place orders and complete transactions on the platform to enhance operations.



T C C

Reducing Carbon without Reducing Strength

Total Climate SERIES

→ Low-carbon Products: Reducing Carbon without Reducing Strength

In Taiwan, a region frequently affected by earthquakes, TCC has demonstrated a firm commitment to the strength and safety of low-carbon products. TCC has introduced the 'Total Climate' series, which offers low-carbon options without compromising on strength. TCC, targeting corporate plants and offices as well as eco-conscious builders and construction companies, join hands with customers to embrace the era of carbon valuation. This strategy steers the industry towards sustainability and marks TCC's evolution from a volume-based supplier to a premium construction brand.



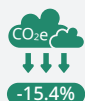
Portland Type I

Suitable for general construction and engineering



Portland Type II(MH)

Low hydration heat
Resistant to sulfate
Suitable for bridge piers and large dams



TCC Low-carbon Cement

Portland Limestone Type IL Cement

- Carbon reduced by 15.4% compared to Portland Type I (base year: 2016)
- Lower carbon, stronger early strength for general construction and engineering
- Cable of completely replacing the traditional Portland Type I
- Production in line with CNS 15286

TCC Low-Carbon Concrete

Portland Limestone Type IL Cement Concrete



Consistent slump, superior workability



Stronger early strength



More actionable, lower carbon emissions



High durability



For general construction and engineering

Item	TCC Low-carbon Ratio Concrete	Portland Limestone Type IL Cement & Concrete
Concrete Slump (cm)	26	26
Compressive Strengths (kgf/cm ²)	1 - Day	110
	3 - Day	330
	7 - Day	488
	14-Day	586
	28-Day	646
Carbon Reduction Rate	Benchmark	≥8%





→ UHPC Construction Material

Ultra-High Performance Concrete (UHPC) is celebrated for its superior durability, strength, and mechanical properties. It transcends traditional construction material limits, revolutionizing the industry with its adaptability to diverse designs, infusing buildings with a new perspective and artistic allure. Esteemed by architects, it's a choice material for iconic global structures.

Comparison of UHPC and Traditional Concrete

Material Nature	Traditional Concrete	TCC UHPC
Compressivestrength (MPa)	20~40	≥120
Flexural strength (MPa)	≤4.5	≥15
Tensile strength (MPa)	<4	≥5
Shrinkage rate (μm/m)	>700	≤300
Impermeability (m ² /sec)	10~50x10 ⁻¹³	≤5x10 ⁻¹³

The test results of UHPC are superior to those of traditional concrete

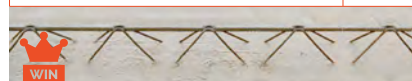
TCC KEY FACT | UHPC Feature

Reduced the thickness of building walls by **-75%**

Extend the lifespan of a building **~120 years**

Reduced carbon emissions compared to traditional concrete **-60%**

→ UHPC Applications



UHPC KT Slab (Precast K-Truss Slab)

- Precast product, eliminating the need for formworkers and floor supports
- Reduce structural net load
- Reduced number of steel bar tying workers & low carbon emissions
- Shortened construction time

VS



Traditional Slabs

- Depression, water accumulation
- Insufficient carrying capacity



UHPC Bricks

Grass pavers

- With resistance to heavy pressure and high durability, allowing the land to breathe
- #### Paving bricks
- High compressive and flexural strengths

VS

Traditional grass pavers & paving bricks

- Depression, water accumulation
- Insufficient load-bearing capacity than traditional paving bricks
- Uneven surfaces & prone to loosening



→ Ultra-High Performance Concrete (UHPC) Production Center

TCC inaugurated the largest Materials Process Center of UHPC at the Hoping Plant in Hualien in 2023. This center produces UHPC mosaic wall panels, KT slabs, grass pavers, and paving bricks. Notably, the EnergyArk Energy Storage Cabinet, a fireproof and fire-extinguishing product, showcases the integration of UHPC with new energy technologies. The smart production design includes an overhead crane system for enhanced process control. The center employs many tribal women, particularly in making UHPC grass pavers, reflecting TCC's commitment to gender inclusivity in its low-carbon transformation. Currently, these products are used in the exterior curtain walls of the TCC DAKA Renewable Resource Recycling Center, the 100-MW energy storage project at the Hoping Plant, and for external clients. TCC plans to further innovate by developing cement or UHPC permeable panels that incorporate recycled construction waste.





→ International TAF-accredited Low-carbon R&D Center

TCC's Low-carbon R&D Center, with top-tier lab equipment, conducts analyses of cement and concrete, ensures product quality, and fosters staff expertise, all while innovating in low-carbon solutions. The Center boasts TAF-accredited labs for material testing of cement, civil engineering and public works. Currently, the Center has 29 employees, nearly 70% of whom hold master's or doctoral degrees.

Following the release of TCC Portland Limestone Type IL Cement, the Center received the "CNS 15286 Blended hydraulic cements" certification in February 2024. TCC is assessing the setup of a TAF-certified SRF lab to address Taiwan's testing gap and boost product standardization and traceability.

Low Carbon Product Certifications

Cement	Ministry of Environment
	Gold-rated Green Mark
	Carbon Footprint Label
	Carbon Footprint Reduction Label
	ISO 14067 Carbon Footprint of Products
	Ministry of the Interior
	Green Building Material Label (to be issued in Q3 2024)
	Bureau of Standards, Metrology and Inspection
	CNS Mark
Concrete	Ministry of Environment
	Carbon Footprint Label
	Carbon Footprint Reduction Label
	Taiwan Architecture & Building Center
	Recycling Green Building Material Label
	ISO 14067 Carbon Footprint of Products
	Good Ready-Mixed Concrete (GRMC)
	Ministry of the Interior
	Green Building Material Label (to be issued in Q3 2024)
UHPC	Ministry of the Interior
	Low-carbon Construction Methods
	(to be completed in Q3 2024)



→ Civil Engineering Testing Laboratory (TAF Accreditation: 4169)

- ✓ Accredited with ISO/IEC 17025:2017 and CNS 17025:2018 quality system laboratory certifications
- ✓ Compliant with the S01 and S02 requirements of the "Accreditation Program for Public Construction Material Laboratory" of Taiwan Accreditation Foundation (TAF)
- ✓ All test methods in compliance with the CNS national standards
- ✓ 8 civil engineering test and experiment accreditation items passed successfully in 2023 (with more to come)

Low-carbon Product R&D

Alternative Raw Materials/Fuels

- Develop new alternative fuels to help reduce carbon emissions in cement and concrete.
- Develop alternative fuels in collaboration with CPC Corporation.
- Engage in the SRF development plan and cement kiln clean integration system in collaboration with the ITRI.
- Develop new alternative raw materials in cooperation with industrial associations.

Green Construction Materials Develop low-carbon cement and concrete while maintaining strength and safety.

Construction Concrete Recycling Converting waste concrete into RCA.

Quality Control

- Inspect and control from time to time; improve and normalize machinery equipment.

Technical Talent Education and Training and Skills Assessment Incentive System

- Organize professional education and training courses on ready-mixed concrete quarterly.
- Establish quality control skills assessment system and link such to incentive system.



2.2_

Low-carbon Production Value Chain

TCC KEY FACT

5G Smart Mine
AI for Optimal Route
Production Efficiency
Increased by **4%**

Eco-friendly
RMC Trucks
(Phase 5
& 6) **79%**

Automated Smart
Warehouse

100% accuracy
of inventory
check 25%
of time saved

Power Generation
by Waste Heat
Recovery | Taiwan
& Mainland China
Cut CO₂e

452,064
metric tons

→ AI-powered Low-carbon, Efficient Production at TCC

AI for Optimal Route and Mining Configuration

In 2022, the Jurong Plant (Jiangsu) became TCC's first 5G smart mine, introducing autonomous electric mining trucks equipped with advanced sensors and cameras for real-time environmental feedback via 5G. AI technology optimizes truck routes, and through software computation, achieves a 100% resource utilization rate.

AI for Optimal Route:

- Automated route planning based on the current ore allocation plan execution rate
- Real-time update on vehicle location

14 Unmanned Electric Mining Trucks

- Approx. 805 metric tons of diesel saved compared to fuel-fired mining trucks Equivalent to 1,751 metric tons of carbon
- Workforce at the mine cut by 76.9%

Ongoing plan to introduce electric mining trucks at suitable plants

Promote low-carbon mining

Land Transport Electrification

AI-powered Smart Logistics System

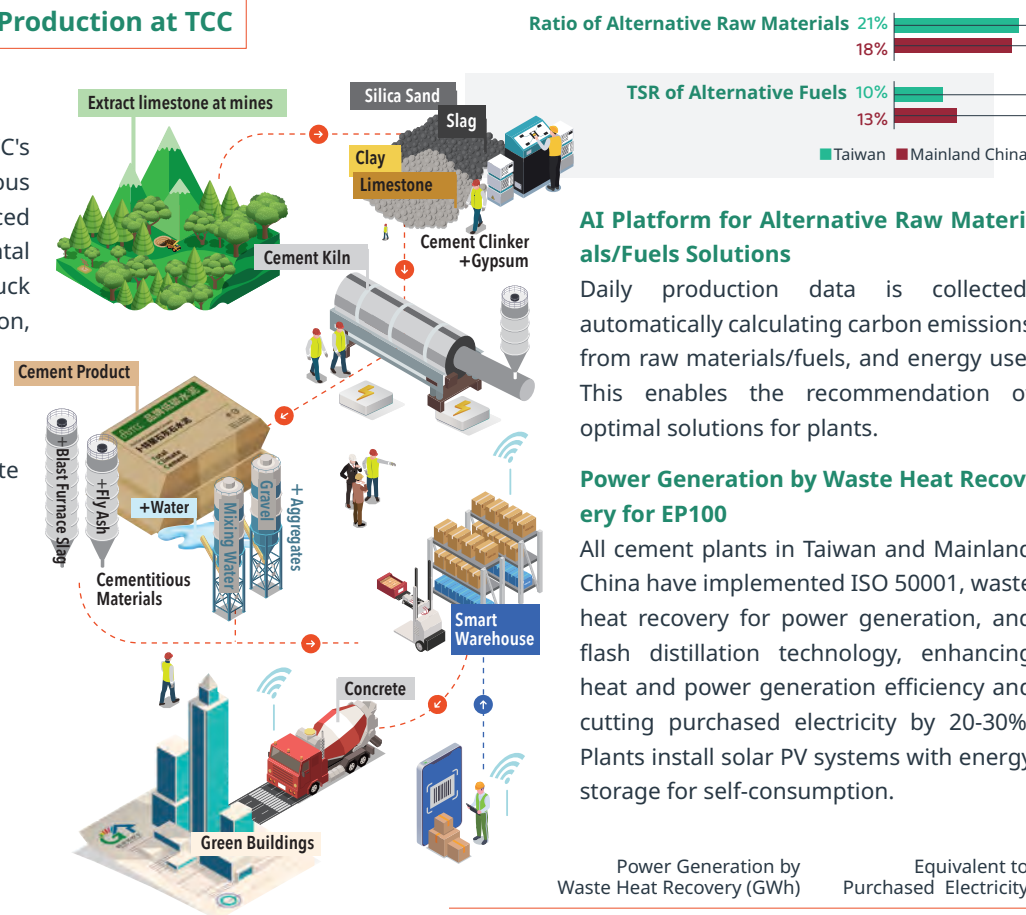
In April 2024, TCC introduced the first 43-ton bulk cement tractor and is upgrading RMC trucks to Phase 6 eco-friendly trucks, while replacing all corporate cars with EVs. TCC is exploring the acquisition of electric trucks, tractors, and mining trucks. TCC has implemented a logistics system that optimizes land, sea, and air transportation by matching cargo needs, reducing empty trips, and enhancing efficiency.

1,752 trips of transportation on land/at sea matched for the Yingde Plant (Guangdong) and Guigang Plant (Guangxi)

413,587.6km of empty trips reduced, carbon emissions -1,049.82 metric tons

GRI 302-4、303-1、303-2、305-7、306-1、306-2、306-3、306-4、306-5

SASB EM-CM-410a.1



AI Platform for Alternative Raw Materials/Fuels Solutions

Daily production data is collected, automatically calculating carbon emissions from raw materials/fuels, and energy use. This enables the recommendation of optimal solutions for plants.

Power Generation by Waste Heat Recovery for EP100

All cement plants in Taiwan and Mainland China have implemented ISO 50001, waste heat recovery for power generation, and flash distillation technology, enhancing heat and power generation efficiency and cutting purchased electricity by 20-30%. Plants install solar PV systems with energy storage for self-consumption.

Automated Smart Warehouse

At Hoping Plant (Hualien) and Shaoguan Plant (Guangdong), smart warehouses use autonomous forklifts for material handling and RFID tags for quick inventory checks. They feature ESL for real-time updates via mobile devices, ensuring a paperless, cloud-based operation. Access control automatically detects and alerts unauthorized access, enhancing security and inventory accuracy.



TAHO AFRICA utilizing AMP System at the Hoping EcoPort

→ Optimized Maritime Routes AMPs to Reduce Carbon Emissions in Port Berthing

Ta-Ho Maritime Corporation, a TCC Group Holdings subsidiary, operates 2 eco-friendly carriers. In 2023, Ta-Ho introduced the "NAPA Voyage Optimization" system for real-time fleet tracking, integrating weather, sea conditions, and port schedules for optimal routing. Additionally, the SEEMP PART III was implemented to reduce vessel carbon intensity. Ta-Ho's vessels, TAHO AFRICA and TAHO OCEANIA, along with TCC's Hoping EcoPort, and the Ports of Taichung and Kaohsiung, have all installed the Alternative Maritime Power (AMP) system in 2023.

TCC KEY FACT

**A young fleet
with an average
age of 6 years**



**New carriers, daily fuel
consumption**



-7.8%

set to launch in Q1 2025

**Average
Carbon
Intensity
Indicator (CII)**

-50%



**Own ships and ports
utilized AMPs
for a total of
2,213.7 hours
cutting carbon
emission by**



**710.3
metric tons**

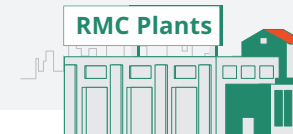
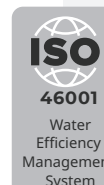
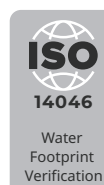
**Optimal routes
varying with
weather conditions
cutting
carbon
emissions by**



4-5%

→ Environmental Management

TCC is dedicated to minimizing its environmental footprint by managing across complete product life cycles. TCC enhances employee environmental knowledge and practices through certification courses, TCC Lyceum, new recruit training, and Town Hall Meetings, focusing on energy, water efficiency, and waste reduction. Plans are underway to boost employees' sustainability awareness and management skills.



→ Energy Efficiency Management



"The 21st century is the energy century, and industries should explore ways to increase energy efficiency. Facing increasing carbon emissions and energy transitions, enhancing energy efficiency is crucial to industries"

Nelson An-ping Chang
Chairman
Taiwan Cement Corporation

CLIMATE GROUP EP100

TCC cement plants in Taiwan and Mainland China are 100% ISO 50001 certified. TCC has joined EP100, targeting a 50% increase in energy productivity by 2040 from 2016. TCC will enhance waste heat recovery power generation, energy-saving technology, and expand alternative fuel use.

For the energy-saving projects and results.

See [CH 6](#)

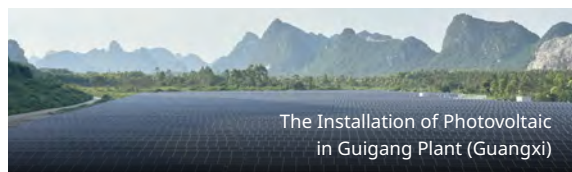
Fulfill Obligations as Energy-heavy Industries with Self Use Renewable Energy Generation

T-REC procurement is not TCC's primary means to reduce carbon emissions. PV systems have been installed to the rooftops and idling spaces at the Headquarters, cement plants, RMC plants, and affiliated enterprises to realize renewable energy installation and generation for self-consumption. The Hoping Plant in Hualien and the Suao Plant in Yilan of TCC are the compulsory users of renewable energy. In 2023, both have fulfilled their obligations as energy-heavy industries ahead of schedule, with 2,803,569 kWh of renewable energy generated, accounting for 0.6% of the total electricity consumption.

TCC KEY FACT

TCC's Energy Efficiency Surpasses Targets, Featured in Progress and Insights Report

CLIMATE GROUP EP100



The Installation of Photovoltaic in Guigang Plant (Guangxi)

In addition, TCC is implementing the "photovoltaic + energy storage" strategy in Mainland China. The Yingde Plant (Guangdong) installed more than 8 MW of PV systems from 2022 to 2023, reducing purchased electricity by 7.1 million kWh in 2023. In August 2023, it unveiled Mainland China's largest cement industry energy storage system at 107.3 MWh, saving around RMB 21.3 million annually by optimizing off-peak/peak power usage.



The PV System on the Rooftop of Smart Warehouse in Hoping Plant (Hualien)

The Guigang Plant (Guangxi) installed PV and energy storage facilities, reaching 7.8 MW of PV and 33.54 MWh of energy storage by end of 2023. This setup generated 6.92 million kWh of electricity in 2023, cutting power losses by 59,000 kWh. The Jurong Mine (Jiangsu) aimed to become a "carbon-free mine" model. In 2023, Yingde (Guangdong), Guigang (Guangxi), and Jurong (Jiangsu) plants collectively produced 14,029,781 kWh of renewable energy for self-use, with clean energy making up 1.1% of usage.



Energy Storage System in Yingde Plant (Guangdong)

First in Industry

TCC Introduces Electric Tractors | Cutting Carbon by 32%

The transportation sector contributes to 12.8% of total GHG emissions, mainly from road transport, with heavy trucks and tractors being significant contributors at 18.31%. TCC is the first in Taiwan by using electric tractors for cement transportation, cutting carbon emissions by 32% and enhancing the carbon footprint of its low-carbon cement products.

In April 2024, Taiwan Transport and Storage Corp. (TTS), a TCC Group Holdings subsidiary, and VOLVO co-hosted the “Low-carbon EV Green Transportation Launch Ceremony” to introduce European electric tractors. The tractors can be attached to various types of semi-trailers, including flatbed trailers, bulk cement tankers, electric compressed garbage trailers, etc. Two electric tractors with mixers will be available this year for cement transportation of TCC.

TTS leads in Taiwan's logistics sector with the most diverse EV fleet, including 26-ton trucks and 43-ton tractors, significantly cutting Scope 3 emissions for key industries and reducing Taiwan's road transport carbon footprint. Planning to expand its electric fleet and offer bespoke solutions, TTS aims to assist corporate clients in achieving verifiable Scope 3 emission reductions. Furthermore, NHOA.TCC, a TCC Group Holdings subsidiary, has installed fast chargers at TCC's RMC plants, boosting vehicle efficiency and ensuring prompt deliveries.



TCC launches new low-carbon labeling, offering customers green services

→ Water Resources Management

TCC prioritizes water resource management, despite the cement industry being less water-intensive than the technology sector. TCC is enhancing its water management and efficiency. To enhance the communication with authorities on water scarcity, TCC holds water supervision meetings quarterly with the Industrial Development Administration, MOEA.

TCC cement plants and RMC plants in Taiwan and Mainland China have 100% ISO 14046 certification, with Taiwan's plants also certified to ISO 46001. In May 2024, Hoping Plant (Hualien) and Suao Plant (Yilan) received the highest Platinum level from the Alliance for Water Stewardship (AWS) after thorough evaluation. A water footprint management platform has been operational for cement plants, tracking water metrics (supply, use, reclamation, and discharge) to enhance water management by allowing real-time calculations of water reclamation rates and comparisons with industry peers. In 2023, Taiwan's cement plants qualified for a preferential water conservation charge rate from the Water Resources Agency due to superior water reclamation rates compared to the industry standard.

TCC is enhancing water efficiency by constructing recycling systems, optimizing pipelines and equipment, and installing water-saving devices. The future water supply was assessed based on the WRI's Aqueduct Water Risk Atlas. See [CH 6.1](#) for the analysis results.



Rainwater Recycling

Rainwater harvesting systems are installed at all operation sites, and reusing rainwater in RMC plants' mixing water, plant irrigation, or tire wash ponds.

Wastewater Management

Wastewater recycling and treatment equipment have installed to all RMC plants, collecting wastewater from manufacturing process. After sand and gravel separation, the wastewater is stored in the sewage ponds for reuse, so as to achieve 100% zero wastewater discharge.

The main sources of wastewater at cement plants are process cooling wastewater and domestic sewage. Various water pollution prevention and control measures are in force, including centralized treatment facilities and silting basins. Internal testing is carried out by the authorities to ensure that the discharged wastewater does not cause irreversible harm to water bodies, ecosystems, and human health.



Plant	2023 Performance	Project	Description	Use of Reclaimed Water
Yilan Suao Plant	<ul style="list-style-type: none">100% process water zero discharge721,287 m³ of water consumed, dropped by 108,000 m³ compared to 2022251,606 m³ of water discharged, cut by 33% compared to 2022. The effluent water, consisting of surface runoff and rainwater, undergoes purification process before being discharged into the Baimi River.	Increasing the utilization of reclaimed water from outfalls	Add pumps and reclaimed water pipelines at outfalls to increase water reclaimed and reduce the use of groundwater.	<ul style="list-style-type: none">For the sprinklers, the tire wash ponds, etc.For the flowers and the environment of the nearby community
		Effluent reclamation from power generation by waste heat recovery	Reclaim effluent from cooling towers.	For the sprinklers, the tire wash ponds, etc.
Hualien Hoping Plant	<ul style="list-style-type: none">8,840 m³ of rainwater runoff from the mine reused54,486 m³ of water reclaimed via the MBR treatment system, achieving 100% domestic sewage recycling, with total water withdrawn decreased by 7.34% compared to 20221,128 m³ of water reclaimed from branch lines14,340 m³ of sewage treated before discharged to the Pacific Ocean	Reuse of rainwater runoff from the mine	Rainwater seeps into the shaft tunnels and converges into ponds.	For the ecological ponds, Ho-Ping Ark Ecological Program, or the reuse in irrigation
		Reuse of reclamation from branch lines	Install new rainwater/wastewater cycling systems to the car wash facilities and sedimentary ponds.	For washing limestone truck hoppers
		MBR treatment system	Filter and treat the domestic sewage on the plant, TCC DAKA, and RRRC.	For the sprinklers, the tire wash ponds, flowerbeds, etc.
RMC Plants	<ul style="list-style-type: none">100% zero wastewater dischargeReuse of rainwater, saving 15,631 m³ of municipal water	Reuse of rainwater into the mixing system	Add rainwater pipelines and harvesting tanks to Taipei RMC Plant.	For mixing water
		Reuse of rainwater runoff on the plant	Install runoff water sedimentary ponds to all plants.	For tire washing, irrigation, etc.
Sichuan Guangan Plant; Huaying Plant Guizhou Anshun Plant (in water-stressed regions)	<ul style="list-style-type: none">72,496 m³ of wastewater from power generation from waste heat recovery and domestic sewage reclaimed10,800 m³ of seepage from the mine reclaimed76,441 m³ of seepage from cable duct reclaimed	Reclamation of wastewater from power generation from waste heat recovery and domestic sewage	Recover the wastewater for treatment and reuse.	For cooling towers and desulfurizers
		Reclamation of belt tunnels' seepage	Converge the seepage via pipelines into catch basins.	For dust suppression sprinkling and tire wash ponds
		Reclamation of cable duct's seepage	Cable duct's seepage flows into wells before pumped into the ponds for power generation.	For power generation from waste heat recovery

→ 2024 Water Resources Action Plans

**Yilan Plant**

Install recycling equipment for the water from conveyor belt washing
Save 3,500 m³ of water per year

**Taoyuan 2nd Branch**

Introduce reclaimed process water into belt washing equipment
Save 4,600 m³ of water per year

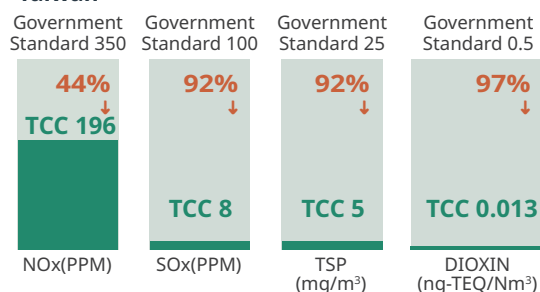
**Hoping Plant (Hualien)**

Complete the rainwater harvesting system installation
Reuse for toilet flushing and sprinkling

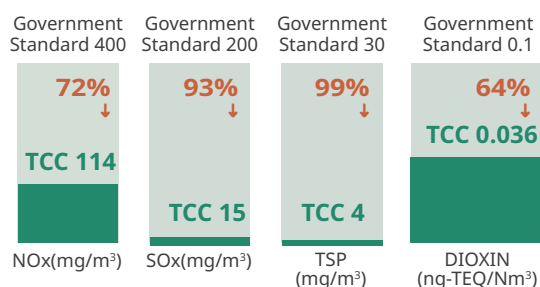
→ Air Emissions Management

TCC rigorously manages its air emissions. In 2023, the emission concentration levels of NO_x, SO_x, Total Suspended Particulate (TSP), and dioxin were all below government standards.

Taiwan



Mainland China



Gaseous Pollutants

Low-sulfur, sub-bituminous coals
Low NO_x burners
Multi-stage combustion equipment
Selective Non-Catalytic Reduction (SNCR) denitrification equipment

Particulate Pollutants

Optimization of bag dust precipitators
Airtightness improvement of the conveyor systems
Ongoing optimization of the electrostatic-bag dust precipitators

24-hour Continuous Emission Monitoring Systems (CEMS)

TCC has equipped all cement plants with 24-hour CEMS and established real-time connections with the Environmental Protection Bureau for comprehensive emissions monitoring. Air quality stations set up at the communities nearby the plants enable prompt response to anomalies or emergencies. Additionally, TCC engages third parties for quarterly air quality and biannual environmental impact assessments, ensuring compliance with regulations.

Hoping Plant (Hualien) The Only in Taiwan | Hilltop Platform Phased-excavation with Vertical Shaft Transport System

The hilltop platform and vertical shaft transport system are adopted. All the mining and transportation are conducted underground and automated, without noise or dust pollution, achieving carbon reduction, safety, and ecological conservation while minimizing environmental impacts and ensuring personnel safety.



Hoping Plant (Hualien)
Jurong (Jiangsu)
& Chongqing Plant

Low-carbon, Negative-pressure Enclosed Corridors Reduce Dust Emissions

TCC has constructed enclosed negative-pressure conveying systems in select plants in Taiwan and Mainland China, using electric belts instead of trucks to transport limestone from mines to plants, significantly reducing dust emissions. Take Hoping Plant (Hualien) as an example, materials undergo size reduction through crushers before being moved via enclosed conveyors. Hence, the need for truck transportation is decreased by 1,600 trips daily, thereby reducing carbon emissions by about 23,000 metric tons annually.

→ Waste Management

All waste from TCC plants is non-hazardous and treated per regulations. Following ISO 14001 certification, each site implements its waste management procedures. Cement plants have set waste goals, aiming to extend these practices to all operational sites by 2024.

On-site Treatment

Cement plants in Taiwan and Mainland China generate maintenance and domestic waste. Valuable industrial waste is reclaimed by certified third-party agencies, while other wastes are recycled via high-temperature rotary kiln treatment for reuse. Cement plants set a goal in 2024 to achieve 100% conversion of waste into renewable resources, striving for "innocuous treatment and resource utilization" practices.

Off-site Disposal

The RMC plants and distribution stations, including Tsing Yi Plant of Hong Kong Cement and E.G.C. Cement Corp., produce non-hazardous domestic and industrial waste, treated by certified vendors. Additionally, valuable metals are recovered and sold to recyclers. TCC Group Holdings' Operation Headquarters¹, Low-carbon R&D Centers, and Mainland China offices mainly generate domestic waste, with strict recycling management regulations. Qualified recyclers provide related evidence (such as handwritten logs and delivery notes) for TCC to track.

¹Note 1 Operation Headquarters data includes subsidiaries, affiliated companies, and foundations located within the building.

Total Climate — Low-carbon Series_Endeavor to Reduce Carbon in Construction & March Towards Low-carbon Cities

Cement is a century-old industry. As long as humans continue to have housing and construction needs, it can almost continue into the next century. Yet, when the storm of carbon fee hits, even the most enduring century-old industry will have to change.



In October 2023, TCC debuted the “Total Climate Series,” highlighting its low-carbon products such as Portland Limestone Type IL cement and concrete and UHPC to key sector leaders. TCC also partnered with Fubon Land Development Co., Ltd. for eco-friendly construction. Following expansion in Europe low-carbon cement business, Chairman Chang set a 2026 target for 100% low-carbon cement and concrete production and sales.



Whole New Launch

From R&D and Manufacturing Process to Sales Models

In 2023, TCC launched the “New Cement Business Development Center” to directly connect with end clients, focusing on supports in new product structures, technologies, carbon reduction assessments, and regulatory guidance, aiming to highlight the benefits of carbon reduction to clients and construction firms. Recognizing the challenges domestic construction companies face compared to their international counterparts in adopting net-zero practices, TCC not only markets high-value products but also provides carbon knowledge services. These services include insights into global carbon reduction trends and updates on relevant regulations, thereby boosting the carbon competitiveness within the value chain. Additionally, TCC has introduced a unique calculation system to help clients quickly evaluate the carbon footprint and reduction potential of buildings using TCC's low-carbon products.

Target Audience: structural engineers associations, architects associations, civil engineers associations, construction companies, technology companies with factories, builders, academic institutions, government agencies, financial institutions, etc.



Total Communication

From Construction to the Public/Private Sectors and Academia

The promotion events held as of April 2024: **223**

TCC participates in various conferences to advance R&D and UHPC design discussions. It was further invited by the Public Construction Commission to lead a seminar on carbon reduction and showcased low-carbon materials at the Hoping Plant. By 2026, Portland Limestone Type IL Cement will 100% replace Portland Type I Cement and further explore UHPC applications, aiming to reduce carbon in construction and improve the industry's climate resilience, progressing towards net-zero cities.

TCC KEY FACT

As of April 2024, nearly 400 project sites have been signed.



Total Climate — Low-carbon Series_Endeavor to Reduce Carbon in Construction & March Towards Low-carbon Cities



Low-carbon Construction Materials Exhibition in TCC Headquarters

→ Immersive Experience for the Total Solution of Low-carbon New Energy

TCC has established a permanent low-carbon construction materials exhibition at its headquarters. Starting with global carbon trends, it educates visitors on the carbon-cement relationship and the significance of carbon reduction in construction. The exhibit also physically displays TCC's renewable energy and energy storage solutions, highlighting achievements in carbon reduction across a building's life cycle. The goal is to work with construction partners to improve carbon competitiveness in the carbon pricing era.



TCC×NTU

Fuse Low-carbon Construction Materials with Design Thinking

TCC collaborated with the "Research Center for Building & Infrastructure Information Modeling and Management" of the Department of Civil Engineering, NTU to co-organize a semester-long capstone course in 2024.



TCC supported teaching assistants, scholarships, and provided DAKA Tower's engineering plans for a course

requiring students to redesign a building with sustainable, low-carbon principles using Building Information Modeling. The curriculum emphasized design thinking, sustainability, and Taiwan's 2050 Net-Zero Emissions goal, urging students to consider "embodied carbon" and select low-carbon materials from the planning phase. It featured a tour of the Operation Headquarters' low-carbon exhibit and a detailed discussion with Chairman Chang on low-carbon cement's uses and benefits.

→ Low-carbon Product Quality Survey

In 2023, TCC conducted a quality survey on its new Portland limestone Type IL cement concrete through online questionnaires sent to 76 clients with orders over 100 cubic meters (excluding small maintenance/construction firms). With a 63-response rate (82.9%), the survey found no quality difference between Type IL and Type I cement, meeting the quality target.



2.3_

Resource Recycling

The core competence of the cement industry - co-processing with cement kiln can achieve innocuous treatment and resources reuse of wastes by the average temperature of over 1,300°C of cement kiln. GCCA highlighted the importance of alternative fuels and materials for the cement industry's sustainable transition.

Low-carbon Product and Circular Economy Engagement

BSMI under M.O.E.A. sets the chloride limit for Portland cement as per CNS 61.

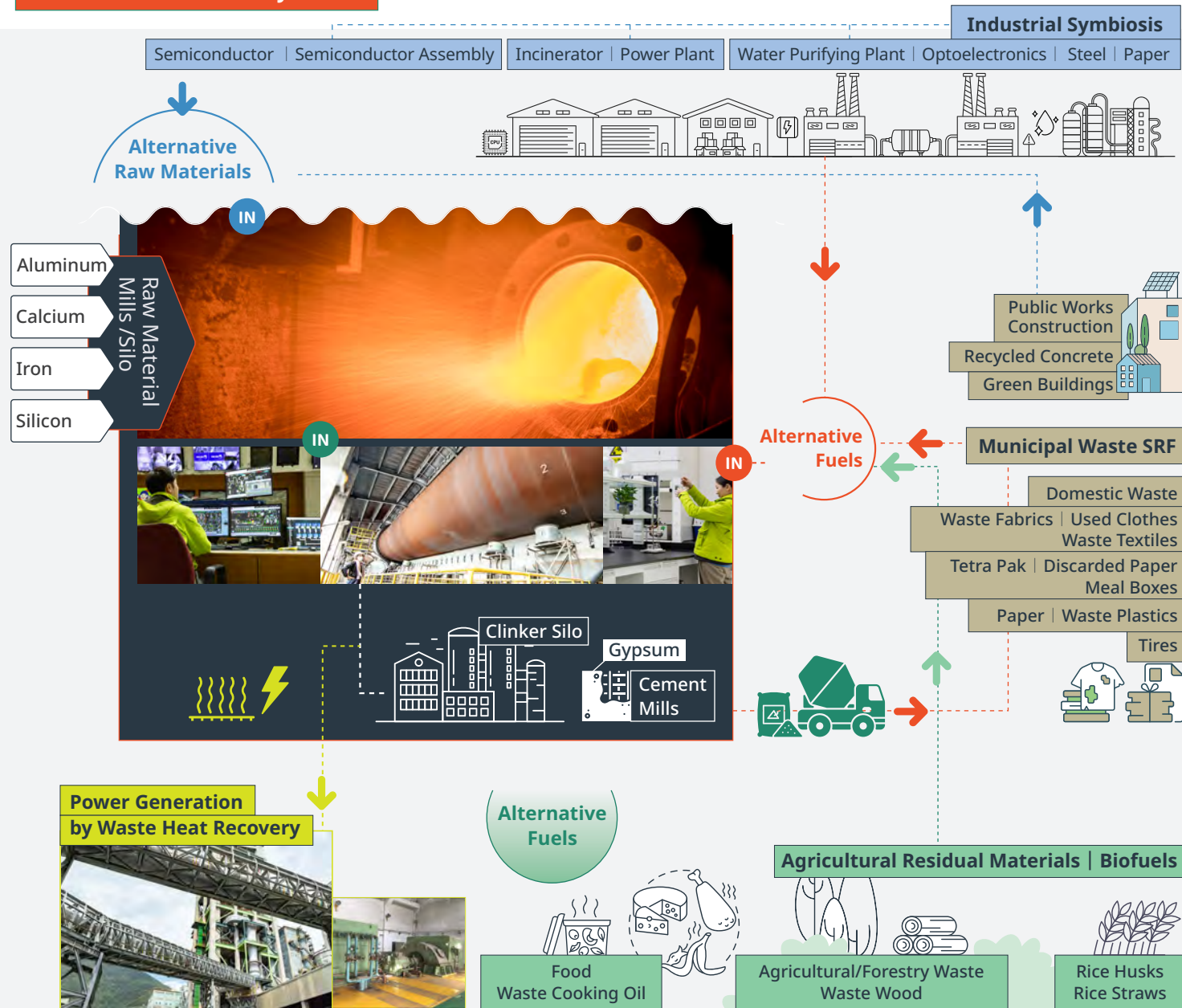
The Public Construction Commission amends the construction guidelines.

The use of alternative fuels by the MOE.

Assisting the Construction and Planning Agency of the MOI in establishing norms for low-carbon cycle construction materials construction methods.

Assisting the Industrial Development Bureau in formulating criteria for green factory evaluations.

→ TCC Circular Economy Model



→ Alternative Fuels

In 2023, TCC continued to develop sources of waste wood, plastics, textiles, and non-hazardous oily sludge. Due to the varied characteristics, extensive testing is required for stable utilization. TCC joined hands with local governments and enterprises to conduct trials. In October 2023, TCC and ITRI jointly completed the construction of the “SRF with high heating value co-firing and clean integration system for cement kiln”. The system performance verification is currently underway. The outcome of the project is also expected to be applied to raise the efficiency of alternative fuels.

Taiwan's cement plants, constrained by the CNS 61 Standard limiting chloride content in cement to 240 ppm, struggle to increase the TSR of alternative fuels. To address this, efforts include dialogues with authorities and installing chlorine bypass equipment to boost alternative fuel usage in cement production.

Use of Alternative Fuels in 2023

Waste textiles	In use
Waste paper	In use
Waste plastics	In use
Waste wood	In use
Construction waste	In use
Rubber sheet	In use
Waste wood chips from White Popinac	In use
Non-hazardous oily sludge	The individual reuse application approved

The Trial of Using Sichuan Pepper Seeds for Alternative Fuel at Guangan Plant (Sichuan)

Since early 2024, Guangan Plant (Sichuan) has been utilizing the residual materials of Sichuan Pepper, a local specialty crop, as alternative fuels. The Guangan Plant has already assessed the characteristics of Sichuan Pepper and its branches. The plant aims to form a joint venture for alternative fuels, utilizing crushed branches from Sichuan Pepper harvests as biofuel and exploring benefits of Sichuan Pepper seed.



White Popinac & Street Trees Co-processed into Biofuels

To combat the invasion of White Popinac and manage street tree accumulation in Taiwan, the Hoping Plant (Hualien) and Suao Plant (Yilan) have partnered with governments and farmers' associations through MOUs to transform White Popinac into biofuels for cement production. This approach enhances removal efficiency, promotes resource recycling, and supports urban environmental and ecological preservation.

■ 45.52 metric tons of White Popinac processed by Hoping Plant in 2023

■ Approximately 346 metric tons of White Popinac, and 1,000 metric tons of street trees, to be processed per year based on the contract signed by Suao Plant in 2024

Fire Prevention and Control for Alternative Fuels

Alternative fuels are key to carbon reduction in the cement industry. Due to the accumulation of various alternative materials, there is a risk of combustion. TCC has established fire safety regulations for alternative fuel systems to improve fire prevention and control at cement plant fuel storage areas.



8 Fire Hoses and 9 Smoke Detectors in Suao's Alternative Fuel Storage

At the Suao Plant (Yilan), the design incorporates temperature detection and fire prevention, including buffer tanks and thermometers in the storage warehouse and a water mist system for temperature control. Upon exceeding specific temperatures, fire-fighting water is released promptly, all monitored by the central control room. Future enhancements will include IR scanning for combustion detection in material piles and smoke detectors on alternative fuel conveyors and hoppers, along with automatic sprinklers.



→ Alternative Raw Materials

TCC is reducing carbon emissions in cement production by using alternative raw materials to decrease clinker usage. Collaborating with industrial associations and businesses, TCC acquires and reuses waste materials as alternatives, including those from other industries. Additionally, TCC continues to develop alternative sources such as calcium silicate boards and construction waste, to effectively reduce carbon emissions and decrease the use of raw materials.

Coal Ash

Construction Waste Soil

Calcium Fluoride Sludge

Alternative Raw Materials/Fuels Used in 2023

Taiwan

▲ Alternative Raw Material ● Alternative Adjunct ★ Alternative Fuel ■ Alternative Clinker

Resource Reused at TCC	Alternative Type	Amount in 2023
Coal Ash	▲	434,709
Desulfurization Gypsum	●	230,922
Construction Waste Soil	▲	201,380
Wood Chips	★	76,281
Reducing Slag from EAF	▲	67,359
Slag	▲	56,993
Calcium Fluoride Sludge	▲	18,269
Domestic Waste	★	13,762
Inorganic Sludge	▲	13,289
Solid Recovered Fuel (SRF)	★	11,670
Blast Furnace Slag	■	11,613
Waste Ceramic	▲	5,592
Sandy Loam	▲	5,184
Spent Refractories	▲	4,668
Incinerated Recycled Aggregates	▲	4,562
Air-cooled Slag	■	3,777
Mineral Fines	▲	3,631
Basic-Oxygen-Furnace (BOF) Slag	▲	2,381
Waste Foundry Sand	▲	750
Gasifier Bottom Slag	▲	649
Water Treatment Plant Sludge	▲	643
Rubber Sheet	★	509
Waste Compression Molding	▲	222
Waste Wood	★	212
Copper Slag	▲	182
Waste Plastic	★	145
Waste Man-Made Fibers	★	83
Non-Hazardous Oily Sludge	★	10
Waste Paper	★	15
Total		1,169,462

Mainland China

Resource Reused at TCC	Alternative Type	Amount in 2023
Metal Slag	▲	1,236,731
Desulfurized Gypsum	●	1,095,306
Fly Ash	▲	893,286
Coal Gangue	▲	676,310
Cinder	▲	563,853
Construction Waste Soil	▲	387,453
Waste Textiles	★	345,114
White Clay	▲	83,233
Biofuels	★	55,474
Industrial Gypsum	▲	41,752
Inorganic Sludge	▲	36,919
Others- Industrial Waste	▲	30,259
Pozzolana	▲	29,561
Waste Tree Roots	★	29,402
Basalt	▲	22,556
Burnt Shale	▲	21,010
Waste Industrial Label Paper	★	19,624
Regenerated Rubber Granules	★	15,553
Solid Recovered Fuel (SRF)	★	13,977
Others- Wastes	★	12,948
Rubber Scraps	★	8,019
Tire Scraps	★	6,773
Tire Crumb	★	5,154
Construction and Demolition Waste (C&DW)	▲	1,075
Plastic Fragments	★	214
Waste Foaming Slag	★	152
Total		5,631,708

→ Alternative Clinker (New Material)

IEA's roadmap highlights cement industry strategies for a low-carbon shift, emphasizing clinker ratio reduction and mixed cement adoption. In addition to using alternative raw materials or limestone to produce clinker, TCC is also searching for new materials as substitutes for clinker.

Limestone	Taiwan/Mainland China
Fly Ash	Taiwan/Mainland China
Calcined Clay	Mainland China, The CÔTE D'IVOIRE Plant
Pozzolana	The Cape Verde Plant
Kaolinite	Ghana mining area
(requires calcination at 700-900°C)	

→ Calcined clay is GCCA's Top Recommended Option

At the Global Cement Conference in June 2023, scholars highlighted that clinker cement with added calcined clay is the most viable carbon reduction solution, potentially cutting emissions by 40%-50% by directly replacing clinker. TCC owns the world's largest calcined clay base in CÔTE D'IVOIRE (Ivory Coast). The calcined clay does not produce carbon dioxide, only releasing steam and some trace emissions.





Co-processing of Domestic Waste with Cement Kilns, First in Taiwan

TCC DAKA RRRC | Commenced Operations in 2023

The WBCSD highlights that cement kilns' high temperatures can break down dioxins, which incinerators cannot. TCC established the TCC DAKA Renewable Resource Recycling Center (RRRC) to process Hualien's domestic waste, utilizing the energy produced to replace some fuels, achieving coal, waste, and carbon reduction. As Taiwan's first to use cement kilns for local waste co-processing, the RRRC possess a daily capacity of 200 metric tons. Moreover, by addressing methane pollution—27.9 times more impactful on global warming than CO₂—the RRRC helps local governments reduce methane emissions and the carbon footprint of waste transport.

To enhance management of alternative materials and costs, TCC has established an environmental technology company and created renewable resource recycling centers in Mainland China, boosting TCC's procurement competitiveness and control over material supply sources.

TCC KEY FACT

13,762 metric tons of waste processed in 2023
Equivalent to **40.09%** of Hualien's total waste²

^{NOTE2} Data Source: Statistics from the Environmental Protection Bureau, Hualien County

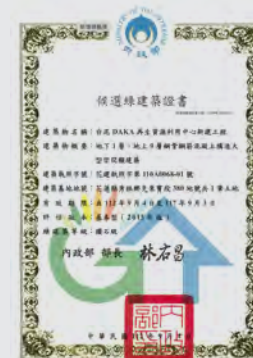
Double Diamond Certifications | Green Building Labeling Diamond Certified & Low-carbon Building BCFd Diamond Certified for the RRRC

Extensive application of the self-developed low-carbon construction materials
Compared to other buildings of similar scale

-23.5% carbon emission

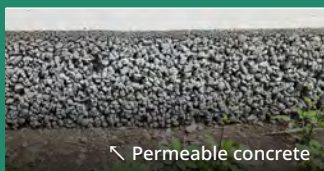


The RRRC obtained the Candidate Green Building Certificate in 2023 and obtained the Low Carbon Building Certification during the architectural drawing stage in February 2024. The RRRC's 60-year carbon footprint is 23.5% lower than similar-scale projects. During building operation and use, the RRRC cut carbon emissions by 12,963.6 metric tons via air conditioning optimization and efficient lighting design.



TCC Low-carbon New Products and New Energy Sites

The main building and surrounding pavements of the RRRC extensively employ construction material products manufactured by TCC. The curtain wall features UHPC panels while the permeable concrete used for roads. Permeable concrete is one of the indicative constructive materials for building a sponge city. It can be used on roads and sidewalks to store and drain water, mitigating the urban heat island effect. Chargers and EnergyArk will be installed around RRRC. Energy storage system is planned to go with ocean thermal energy conversion (OTEC) in the future. Future plans include utilizing OTEC, properly treating seawater, and then introducing it into the RRRC chiller for heat exchange.



Permeable concrete

Can withstand 210 kg/cm² pressure, meeting strength, carbon reduction, and environmental protection standards.

The Carbon Reduction Designs at RRRC



Rainwater harvesting and water-saving appliances

Eaves rainwater harvesting system

Water retention design with confluence channels for green spaces

Rainwater reuse for the automatic moisture-sensing irrigation system

Water-saving appliances



Rooftop PV system for power for self-consumption

Installed capacity: 346.8 kW

Solar panel coverage: 75%



Reduced air conditioning load

CO₂ Concentration-based Demand Controlled Ventilation system

Energy recovery ventilator

Cooling towers designed with wet-bulb temperature controlled VFD fans

VAV and VWV designs



High-efficiency lighting with energy-saving design

Adoption of LED energy-efficient lighting

Skylight design to increase natural lighting

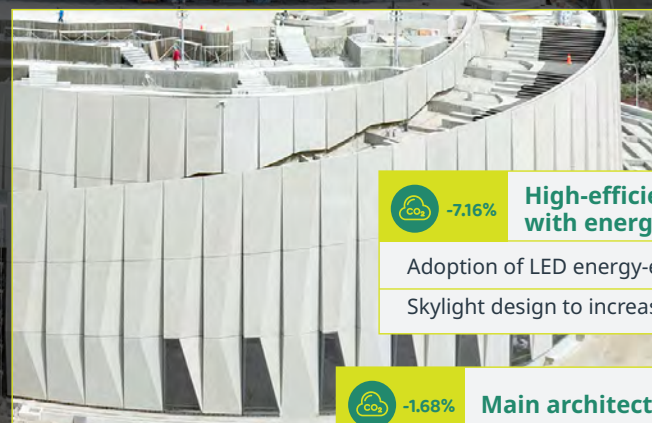
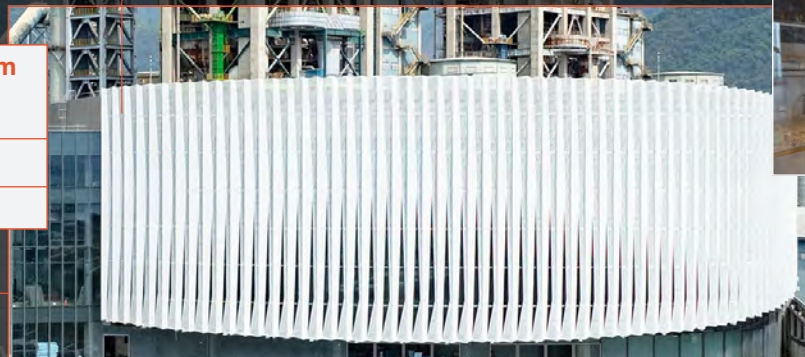


Main architecture durability

25% higher than the designed seismic resistance

0.5cm thicker than the statutory standard

of that of the concrete cover of reinforcement bars in RC columns, beams, and slabs





The Only Fly Ash Co-Processing Cement Kiln in Jiangsu

In 2021, the Jurong Plant (Jiangsu) built a co-processing facility using its cement kiln, incorporating "FWD Technology" for zero wastewater discharge and salt separation, to process fly ash from regional domestic waste incineration. The Jurong plant employs a washing system to remove chlorine from fly ash for reuse as raw material, recycling the washing liquid after purification and distillation without causing secondary pollution.

Yingde Plant's Food Waste Treatment Center Reduces Methane Emissions

Food Waste Landfill is a Major Methane Source

The center processes food waste into liquid and solid forms. The solids become organic fertilizer, while the liquids yield oil for soap and candles, and water for liquid fertilizer. The center also helps local residents and eateries recycle food waste. Hoping Plant established the Food Waste Reuse Center in 2021 to transform food waste into soil amendments. Both plants invested over 27.99 million from 2020 to 2023.

TCC KEY FACT

The Yingde Plant Monthly Food Waste Processing Capacity: approx. **5.1** metric tons

Fertilizer productivity: approx. 1.5 tons

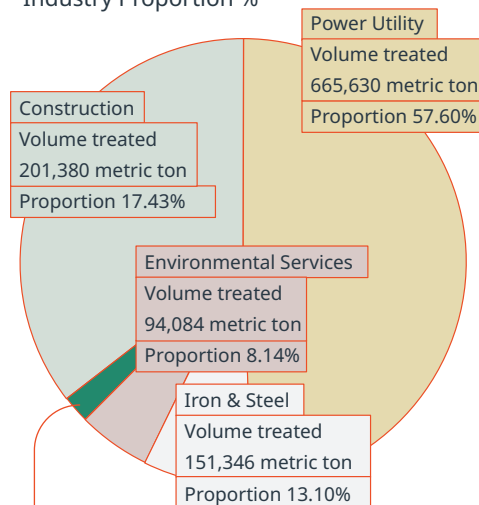
The Jurong Plant Processed fly ash for **5,818** metric tons

→ Cross-Industrial Circular Symbiotic Ecosphere

Committed to circular production, TCC leverages the characteristics and core competencies of cement industry, maintains communication with various stakeholders, and collaboratively builds a circular economy sphere with industries, governments, cities, and the general public. TCC helps diverse industries to treat industrial wastes that are difficult to process and reuse them as alternative raw materials and fuels for cement manufacturing.

Taiwan | Source of Waste

Industry Proportion %



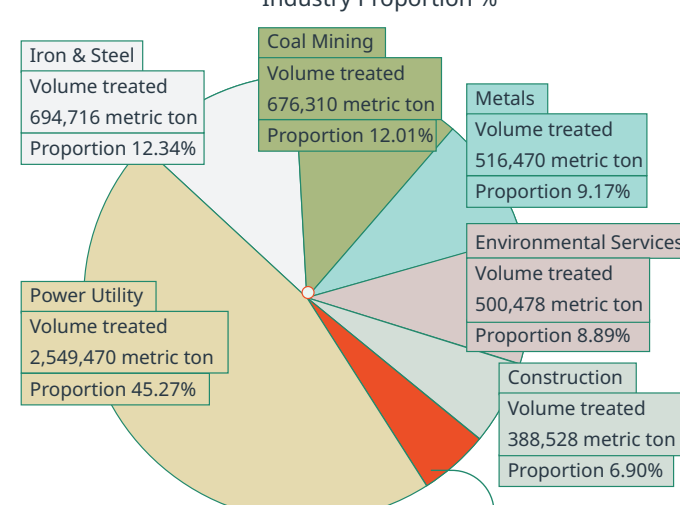
Source Industry of Wastes	Volume treated (metric ton)	Proportion
Semiconductor	18,269	1.58%
Paper	8,020	0.69%
Petrochemical	5,280	0.46%
Waste Incineration	5,211	0.45%
Metals	933	0.08%

TCC KEY FACT

Total Volume treated **1,155,684** metric tons

Mainland China | Source of Waste

Industry Proportion %



Source Industry of Wastes	Volume treated (metric ton)	Proportion
Water Treatment Plant	643	0.06%
Semiconductor	222	0.02%
Assembly		
Self-treated	4,668	0.40%

Source Industry of Wastes	Volume treated (metric ton)	Proportion
Chemical	116,644	2.07%
Paper	83,520	1.48%
Mining	73,128	1.30%
Semiconductor	20,518	0.36%
Tire	11,927	0.21%

TCC KEY FACT

Total Volume treated **5,631,708** metric tons

Whole Lifecycle Services for Buildings - Construction Waste Solutions

"We are currently dealing with astronomical figures in handling construction waste after demolition, and the handling is not adequate. In the future, what we hope to do is to recycle and reuse all the ready-mixed concrete after building demolition, which will not only reduce carbon emissions but also will not affect the strength quality."

~Chairman Nelson An-ping Chang

In recent years, with the rise of urban renewal and public and residential construction projects, Taiwan generated over 2.1 million metric tons of construction waste in 2022, as per MOE statistics. By 2023, 25% of Taiwan's construction waste recycling facilities were still unlicensed³. The legal disposal and subsequent treatment of this waste are crucial for the government, highlighting the importance of resource recovery and reuse.

In 2023, TCC invested in the recycling and treatment of construction waste, designing the Hualien Plant designated as a construction waste treatment site. With the authorities' approval, a construction industry recycling chain has been established, enabling a circular economy with a monthly treatment capacity of 12,000 metric tons.

TCC processes waste and leverages R&D to repurpose construction waste through element analysis, sampling, testing, and trial production, ensuring product quality and strength. Meanwhile, the Company also ensures its compliance with air emissions standards during the manufacturing process. TCC is prioritizing high-quality material sourcing and ensuring enclosed transportation to minimize dust pollution.

- After experiments, construction waste can be used as filler for graded aggregate, fine aggregate or admixture for concrete, and alternative clay for cement.
- The remainders are sorted as alternative fuels for the cement plant.

In 2023, TCC successfully transformed waste concrete into recycled concrete aggregates, with tests confirming RCA's mechanical strength matches that of natural sand and gravel. The initial products developed have been applied to the roads around the RRRC, such as **permeable concrete pavements, for which construction waste are used as the lower coarse material of the pavement. Hence, by reducing carbon without reducing strength, TCC boosts resilience against extreme precipitation and earthquakes.**

Guangdong's Qingyuan region faces construction waste issues, traditionally managed through landfilling, with a low resource utilization rate of about 1.5%. The Yingde Plant (Guangdong) cooperated with the local authorities to recycle urban construction waste, using it as alternative raw materials and fuels. It is projected to obtain a government franchise permit by the end of 2024.

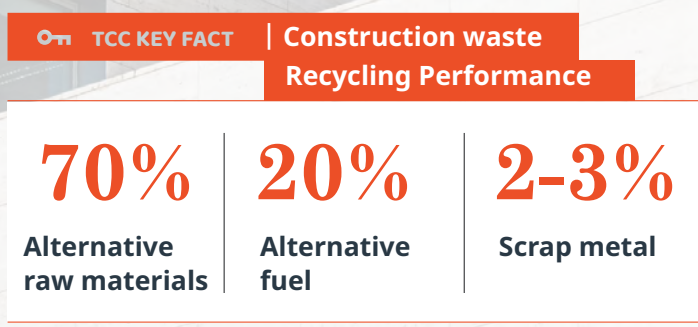


Construction Waste Processing Zone in the Yingde Plant (Guangdong)

→ Construction Waste Treatment Process

- 1 Recover construction waste, with strict requirements for materials and transportation.
- 2 Sort and crush.
- 3 The Low-carbon R&D Center conducts experiment and research.
- 4 Cement plant or RMC plant engages trial production, while the Low-carbon R&D Center verifies product quality and strength.
- 5 Officially reuse.

NOTE³ Source: PTS News Network (2023): <https://news.pts.org.tw/article/668911>



The construction industry heavily demands raw materials and energy. TCC adopts goal-oriented strategy, exploring construction waste solutions to pioneer a circular economy model for the construction ecosystem.



OYAK&Cimpor Overseas Cement Businesses

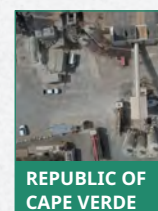


→ Global Development with the Lowest-carbon Cement

TCC has been expanding its overseas presence. Starting from 2018, it partnered with OYAK, the largest cement company in Turkey, to establish a subsidiary. In 2019, TCC acquired CIMPOR, accumulating 2.37 million metric tons of carbon credits in Europe to date. In 2024 Q1, TCC further expanded its investment in the cement market in Europe, Asia, and Africa, becoming one of the significant low-carbon cement suppliers in Europe.

CIMPOR and OYAK are both members of the SBT Business Ambition for 1.5°C campaign member, with OYAK being the first cement company in Turkey to announce a net-zero commitment and complete the setting of a 1.5°C target. OYAK, through CIMPOR, has obtained ultra-low-carbon materials in Africa, positioning itself at the forefront of the global cement sector. After securing the management right of CIMPOR, TCC will expand its low-carbon R&D and continue to develop ultra-low carbon cement. Aiming to become one of the brands capable of producing the lowest carbon cement in the world by 2025, TCC is ambitiously pursuing the goal of Net Zero by 2050.

Located at the junction of Europe, Asia, and Africa, Turkey benefits from its position for exporting low-carbon products to the EU. The World Bank predicts Turkey will need a US\$600 billion investment for earthquake-proofing and reconstruction, boosting cement demand. Research Nester forecasts the European low-carbon cement market to expand at an 8.5% CAGR from 2022 to 2030. TCC believes that with the EU's implementation of the CBAM, low-carbon emissions will be crucial for competing in the European market, affecting both local and imported cement.





→ OYAK Group in the Turkish Market_ AI Manufacturing Processes

OYAK owns 7 cement plants, 11 clinker production lines, including 1 white cement production lines, 67 concrete plants, 50 distribution stations, and 1 port in Turkey. Its Aslan plant emits 628 kg CO₂ per ton of cement, and the Ankara Plant 652 kg, both well below the global average of 900 kg for traditional cement, showcasing superior carbon reduction.

OYAK is advancing the "OYAK Cement 4.0 Project" for digital transformation, leveraging AI to analyze cement plants' operational data for better energy efficiency management in production. This AI integration reduces the thermal energy per clinker unit, cutting fossil fuel use and carbon emissions. Additionally, AI optimizes the co-processing of biomass and RDF, further decreasing fossil fuel dependency and achieving the goal of reduced fossil fuel consumption.



OYAK BOLU PLANT



OYAK MARDIN PLANT



OYAK Co-processing of C&D Waste



On February 6, 2023, a 7.8-magnitude strong earthquake struck Turkey, inflicting severe damage and resulting in collapses of 300,000 buildings. According to the estimates of the UN, the strong earthquake might generate up to 210 million metric tons of debris in Turkey, equivalent to 14,000 football fields piled with 3 feet tall of debris.

OYAK planned to leverage the core competence of the cement industry for waste co-processing, assisting in post-disaster cleanup and reconstruction efforts. Meanwhile, it aims to properly utilize waste resources, achieving the synergy of a circular economy. Research shows that besides recycling concrete waste into aggregates, sand, and gravel for concrete, the dust from recycled concrete can also be used as an alternative raw material for cement.

OYAK aims to extend its recycling process to cities like Istanbul and pilot it in Portugal, aiming to cut natural resource use and achieve carbon reduction.





→ CIMPOR in the Portuguese Market_Accumulated Carbon Credits from Low-carbon Cement

CIMPOR operates 3 EMAS-certified cement plants in Portugal, with a annual clinker capacity nearly 5 million metric tons. The Alhandra Plant is the plant with the largest production capacity of CIMPOR, using alternative fuels of tires, animal feed, wood, and bioenergy to reduce dependence on fossil fuels. The plant aims to complete the clinker production line optimization project by 2025. In 2023, the Souselas Plant achieved an average 613 kg of GHG emissions per metric ton of cement, setting a TCC Group Holdings record, thus acquiring a huge amount of carbon credits.



CIMPOR ALHANDRA PLANT



ALQUEVA DAM



CIMPOR CAMEROUN KRIBI

→ CIMPOR in the African Market_New Materials and Technologies

CIMPOR has established the world's first large-scale calcined clay cement facility in Côte d'Ivoire (Ivory Coast). The calcined clay, when mixed with clinker, reduces carbon emissions by at least 40% compared to the traditional cement. By optimizing the biofuel heat treatment, the Ivory Coast Plant aims to halve its calcined clay's carbon footprint from 200 kgCO₂e to 100 kgCO₂e per metric ton by the end of 2024, achieving a 50% reduction in emissions.

'Cape Verde,' which means 'Green Cape' in Portuguese, possesses abundant natural volcanic ash resources. When used as an alternative to clinker, for example, in CEM II 42.5 type cement, it can replace traditional clinker, which emits 750-800 kg of CO₂ per ton, with zero carbon emissions per ton of volcanic ash.

Meanwhile, CIMPOR found Kaolinite in Ghana, beneficial for the calcination process due to its lower temperature chemical reactions, enhancing energy efficiency. The Ghana Plant is set to start operations by end of 2025.

The Kribi Plant in Cameroon, one of just two worldwide commercial cement plants, uses 90% biofuel and premier flash calcination technology, significantly reducing carbon with its energy-efficient process and clinker substitution.